

Nutrition of the Elderly

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The progressively increasing number of elderly people in the Canadian population and the disproportionate expenditure on their health care has stimulated interest in prevention of common illnesses observed in this age group. It is now recognized that nutrition plays an important role in health status, and both undernutrition and overnutrition are associated with greater risk of morbidity and mortality. Nutritional problems in the elderly can be suspected if there are several high-risk factors present — for example, living alone, physical or mental disability, recent loss of spouse or friend, weight loss, use of multiple medications, poverty, and high consumption of alcohol. Physical examination, anthropometry, and measurements of serum albumin levels and hemoglobin and lymphocyte counts are simple but helpful tools in confirming the presence of nutritional disorders. The prevention and correction of nutritional problems is likely to prove beneficial in the management of common geriatric illnesses. In these efforts, it is desirable to have a team approach in which the physician, the dietitian and the nurse each have a defined interactive role. Home care support services are important adjuncts in continuing care. Nutrition should receive a greater emphasis in the training of physicians and other health professionals.

"A proud and resourceful nation can no longer ask its older people to live in constant fear of a serious illness. We owe them the right of dignity in sickness as well as in health. Too many elderly people . . . skimp on food at a time when their health requires greater quantity, variety and balance in their diets."

— John F. Kennedy

Diet, health and illness are intimately intertwined. Undoubtedly, this concept applies to all age groups, but it is most relevant to the elderly.¹ Indeed, in old age, inappropriate dietary intake contributes significantly to both chronic and acute morbidity, and illness affects food intake and further compromises resistance to disease. A well-balanced diet and adequate nutrition are fundamental to preventive and therapeutic management in the elderly with a primary aim of improving the quality of life rather than increasing longevity.

In Canada, as in other industrialized countries, the health problems of senior citizens pose increas-

ing medical, economic and social concerns. The elderly are a progressively increasing segment of our population and require a disproportionate amount of health care resources. In Canada, people over 65 years of age constitute about 11% of the population and it has been estimated that they account for 30% to 40% of medical and nursing expenses (R.K. Chandra: unpublished data, 1991). The most common causes of illness comprise chronic degenerative diseases, including cardiovascular disorders, cancer, metabolic disorders, physical disability and acute illnesses such as infection. Thus the state of their health is a matter of great concern not only to the

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elderly but also to health professionals, sociologists, economists, politicians and administrators.

Several studies have documented the alterations in physiologic functions that occur with aging.¹ There is a continuum of such changes, from normal to pathologic. At the same time, recent observations indicate that although the average physiologic performance of the elderly is reduced, the range of abilities varies much more than in younger groups.² Many people over the age of 70 exhibit cardiac, renal, gastrointestinal and immunological functions equal to those in young adults. Individual ability is likely to be partly dependent on genetic factors, and there is increasing evidence that dietary intake and nutritional status may be critical determinants of this heterogeneity in old age.³ This finding has both preventive and therapeutic implications.

The key questions about nutrition, health and aging include What available methods can be used to estimate dietary intake and what clinical pointers indicate nutritional deficiencies? What are the major determinants of dietary intake and nutritional status of senior citizens? What practical approaches can be recommended for the prevention and management of nutritional problems in the elderly?

Under the chairmanship of one of us (R.K.C.) four people representing different disciplines — physiology, family medicine, geriatrics, nutrition and dietetics — were invited to form an advisory group to prepare a review on nutrition in the elderly, on Canadian issues with the family physician as the principal audience. Following preliminary discussion, each member was assigned a portion of the topic to review. Draft sections were circulated to all members, and the advisory group met for 2 days to prepare a semifinal draft. The final version was compiled by the chairman in consultation with all the contributors.

This paper provides a background to the role of nutrition as an important determinant of healthy aging and includes practical recommendations for the assessment of dietary intake and nutritional status and the prevention and correction of nutritional problems in senior citizens. Family physicians have an important role in geriatric assessment, and it is expected that they will coordinate both preventive and therapeutic aspects of nutrition in the elderly.

Demographic considerations

The Canadian population is aging rapidly. In 1986, there were 2.7 million people 65 years and older, representing 10.7% of the total population.⁴ Over the last decade the increase has been greater than that over the previous 30 years. The proportion of elderly in the population is expected to increase in the coming years, exceeding 20% in 2021.⁵ The most

dramatic shifts in our population are occurring within the older population itself. In 1961, the proportion of Canadians aged 80 and over was less than 1%; in 1984, there were more than half a million, representing almost 20% of the elderly; by 2021, this proportion will rise to 30%.⁵ This demographic trend is of much interest and concern, because the rate of use of support services of all kinds inevitably increases with age.⁴

In Canada, almost three seniors out of five are women, a result of women having a longer life expectancy. Data for 1985–87 indicated a life expectancy at birth of 73.0 years for men and 79.7 years for women. At present, men reaching 65 are expected to live another 14.9 years and women 19.1 years.⁶ The sex structure of the aging population creates its own set of health and social issues. Several health problems produce greater functional limitation in women than in men, such as depression (with loss of appetite), Alzheimer's disease and osteoporosis.⁷ Although both men and women increase their use of health services as they age, women are greater users of these services at all ages and older women use more than twice as many prescription drugs and more nonprescription drugs than older men.⁸ Besides health aspects of an aging female population, far more women than men experience poverty and loneliness. It is estimated that 31% of Canadian women aged 65 and over live at or below the poverty line, compared with 19% of men in the same age group.⁷

As a whole, our older population remains functionally well until very advanced age; approximately 80% of seniors in Canada are capable of living independently and caring for themselves, probably because of better health and greater reliance on community services than before.⁷ However, at least 12% of the elderly living in the community need assistance with their daily activities, including preparation of meals, and as many as 25% need help with housework and shopping.⁹ As expected, many live alone; after 75 years of age this is true for 15% of men and 40% of women.⁴ Living arrangements, advanced age, health status and family relationships all have a role in determining admission to a long-term care institution.⁹ However, living with a spouse and the availability of relatives to provide assistance tend to delay application for admission to an institution. The overall prevalence of institutional health care for the elderly is estimated to be around 8% in Canada, depending on the definition of long-term care.⁹ The proportion of institutionalized elderly Canadians increases significantly after 80 years of age. In 1986, 11.8% of men and 17.2% of women aged 80 to 84 were residents of institutions.⁴ Residents of chronic care hospitals tend to be older than in the past (Fig. 1).

Physical health is the single most important contributor to the quality of life for the elderly. Seventy five percent of older people suffer from at least one chronic health problem, ranging from arthritis to cardiovascular problems.¹⁰ The latest data available for hospital admission by age show that seniors over 65 account for more than 50% of all patients hospitalized for neoplasms (men only), nutritional deficiencies, anemia, Parkinson's disease, atherosclerosis, fracture of the femur and senility.¹¹

Under Canada's health care system, there is also

a financial incentive to keep the elderly population active, independent and healthy. Of all men hospitalized for various indications during 1988-89, 53.5% were over 65; the corresponding proportion for women was 56.8%.¹¹ Whereas the elderly represent just over 10% of the total population, the costs of medical care that can be attributed to seniors over 65 years of age amount to more than 30% of total health care expenses.

Nutritional recommendations for the elderly

The 1990 recommended nutrient intakes (RNIs) for Canadians over 50 years¹² are summarized in Table 1. Unfortunately, there is little research defining actual nutritional requirements of the elderly. The recommended intakes are generally based on those for younger populations adjusted for age-related changes, such as decline in basal metabolic rate and reduced physical activity. However, these recommendations are applicable to healthy people and may not be appropriate for those who are ill or in institutions. The RNIs represent the average requirement plus two standard deviations to take into account individual variability, except for energy, where average requirements are given. RNIs have changed very little since 1983,¹³ except that for vitamin D, which has doubled. The increase from 2.5 to 5 μ /d was based on recent evidence that the

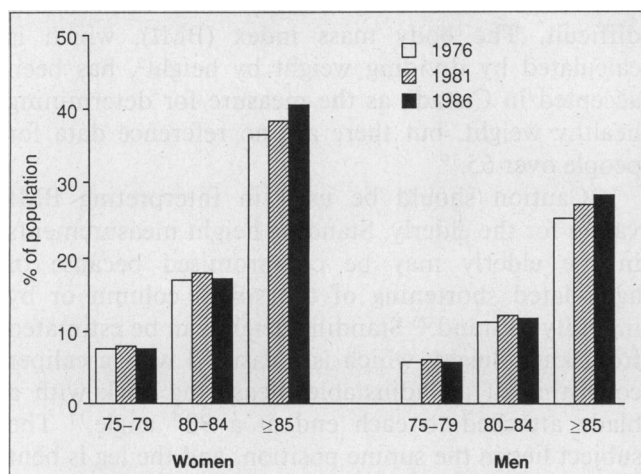


Fig. 1: Percentage of men and women aged 75 years and older in institutions, 1976, 1981 and 1986.⁴

Table 1: Recommended daily nutrient intakes based on age and body weight¹²

Nutrient	Age; sex			
	50-74 yrs		≥ 75 yrs	
	Male (73 kg)	Female (63 kg)	Male (69 kg)	Female (64 kg)
Protein (g)	63	54	57	47
Energy (J)†	9623	7531	8368	7112
Vitamin A (RE)*	1000	800	1000	800
Vitamin D (μ g)	5	5	5	5
Vitamin E (mg)	7	6	6	5
Vitamin C (mg)‡	40	30	40	30
Folate (μ g)	230	195	215	200
Vitamin B ₁₂ (μ g)	1.0	1.0	1.0	1.0
Calcium (mg)	800	800	800	800
Phosphorus (mg)	1000	850	1000	850
Magnesium (mg)	250	210	230	210
Iron (mg)	9	8	9	8
Iodine (μ g)	160	160	160	160
Zinc (mg)	12	9	12	9
Thiamin (mg)	0.9	0.8§	0.8	0.8§
Riboflavin (mg)	1.2	1.0§	1.0	1.0§
Niacin (NE)*	16	14 §	14	14 §
n-3 PUFA (g)*	1.3	1.1§	1.1	1.1§
n-6 PUFA (g)	8	7 §	7	7 §

*RE = retinol equivalents; NE = niacin equivalents; PUFA = polyunsaturated fatty acids.

†Assumes moderate physical activity.

‡Smokers should increase vitamin C intake by 50%.

§Level below which intake should not fall.

elderly have higher requirements than younger adults for vitamin D and may be exposed less frequently to sunlight.^{14,15}

Although the RNIs are designed to ensure nutritional adequacy, the recommendations give guidance for a healthy diet that, together with other healthy life-style factors, will reduce the risk for chronic illnesses such as heart disease and some forms of cancer. The preventive benefit expected from following these recommendations will depend on the age at which they are implemented and how long they are followed.

Assessment of nutritional status of the elderly

The objectives of evaluating the nutritional status of elderly persons are as follows:

- To determine the risk of significant nutritional disorders.
- To assess the reserves available to the patient.
- To identify any nutrition-related disease that may be present and assess its severity.

No management plan can be successful unless it is founded on these objectives.

Nutritional assessment includes careful collection of history, physical examination, dietary assessment and estimation of functional capacity. Laboratory evaluation may also be needed.

Dietary assessment

Several methods for determining dietary intake exist: diet history, 24-hour recall, food records and food frequency questionnaires. Each of these methods has its shortcomings and advantages. For example, memory problems may make dietary recall methods inappropriate, and physical disabilities make recording food intake difficult. Wu¹⁶ designed a 99-item food frequency questionnaire specific to elderly Canadians that was a reliable method for collecting group nutrient intake data. She found that elderly women provided more reliable data than elderly men. Physicians should ask their elderly patients about usual intake and, where indicated, refer them to a dietitian to have a food frequency questionnaire administered and analysed for nutrient intake.

Anthropometric assessment

Measurements of height, weight, skeletal breadth, body and limb circumferences and skinfold thicknesses may be used as indirect measures of body composition and, therefore, as measures of nutritional status.¹⁷ Several challenges are presented

in anthropometric assessment of the elderly because of a lack of standardized measurement techniques and few reference data for this age group. Changes in body composition that accompany "normal" aging make interpretation of anthropometric data difficult. Nevertheless, measurements of the adipose and skeletal tissue of the body do give an indication of energy and protein reserves,¹⁸ and height, weight and skinfold thickness can be used to determine the degree to which a person is obese or underweight. Unfortunately, interpretation of height and weight data as a measure of healthy body fat remains difficult. The body mass index (BMI), which is calculated by dividing weight by height², has been accepted in Canada as the measure for determining healthy weight, but there are no reference data for people over 65.¹⁹

Caution should be used in interpreting BMI values for the elderly. Standing height measurements in the elderly may be compromised because of age-related shortening of the spinal column or by inability to stand.²⁰ Standing height can be estimated from knee height, which is measured with a caliper consisting of an adjustable measuring stick with a blade attached to each end at a 90° angle.¹⁷ The subject lies in the supine position, and the leg is bent at the knee at a 90° angle. A nomogram or formula is used to estimate stature from knee length. Using a sample of elderly Canadians, Wu¹⁶ reported significant correlations between standing and knee height measures for both men and women. Although there are serious problems associated with interpretation of anthropometric measurements in the elderly, it is important to document changes in these indicators as a possible reflection of changes in nutritional status.

Functional nutritional assessment

Assessment of sensory perception forms an important element of any nutritional evaluation. One should note whether impairment of sight, taste or smell is sufficient to affect nutrient intake.

Evaluation of mental status should include enquiries about food preferences and dietary recall. Dentition should be assessed. Swallowing abnormalities should be sought in patients with any form of neurodegenerative disease and in association with head and neck neoplasms. In selected people, video-fluoroscopic examination can be most helpful in determining the degree of aspiration and in identifying the most appropriate consistency for food.

The results of such studies should always be correlated with clinical observations. Respiratory dysfunction, especially dyspnea, may interfere significantly with eating. Any mobility impairment that affects the feeding process can be significant. Coordi-

nation of hand-to-mouth movements is essential for handling common eating utensils and a functional assessment should include inquiry into this area. Similarly, one should note the level of assistance required at meal times.

Laboratory assessment

Many biochemical, immunologic and hematologic parameters are altered by aging and may be difficult to interpret in older people. However, any abnormally low value should be assumed to have causes other than normal aging. Of particular importance in nutritional assessment are the following.

Serum protein level

The serum protein level reflects visceral protein synthesis. Total serum protein level is less useful than the serum albumin level as a nutritional indicator.¹⁷ Repeated measurement of serum albumin levels remains the most accessible and least expensive biochemical indicator of protein status. However, the relatively long half-life of human albumin makes it a poor indicator for early malnutrition, for which serum prealbumin levels are a better index.¹⁷

Serum cholesterol level

Cholesterol levels are often low in the presence of protein-energy malnutrition (PEM). Hypocholesterolemia has been associated with an increased risk of death among the elderly.¹

Hematology

Hemoglobin and hematocrit levels are simple and useful indicators of nutritional status. In the presence of anemia, serum iron, folate and vitamin B₁₂ levels should be determined.

Total lymphocyte count

This is a good, though nonspecific, indicator of PEM. An absolute lymphocyte count less than 1500 per mm³ indicates malnutrition if other causes of lymphopenia can be excluded.²¹ Moderate to severe malnutrition is associated with more marked lymphopenia.²²

Prevalence of nutritional problems

There have been no national surveys of the nutritional status of elderly Canadians since the Nutrition Canada survey of 20 years ago.²³ It identified people over 65 as the group in the general population at highest risk for nutritional problems.

Data from smaller scale surveys conducted in the last decade indicate that nutrition problems are common in the elderly.²⁴

Recent studies show that many elderly Canadians consume less energy than recommended.²⁵⁻²⁷ A mean energy intake of 1400 kcal (6 MJ) a day is not uncommon for elderly women. Although this may not pose a problem in terms of meeting energy needs, intakes below 1800 kcal/d may result in inadequate levels of essential micronutrients. Interestingly, low energy intake may coexist with high prevalence of obesity in the elderly. For example, the Canada's Health Promotion Survey²⁸ found that 20% of Canadians over 65 years had BMI values that placed them in the overweight category; another 21% of men and 15% of women were described as *possibly* overweight. In addition, 8% of men and 15% of women in this age group had BMI values that placed them in the underweight category. Imbach and colleagues,²⁹ in a Montreal study of low-income seniors, found that 28% of elderly women were obese and 23% of men were underweight.

In Canada, 10% to 28% of the elderly are at risk for dietary deficiency of calcium, β -carotene and vitamins D, A and C.^{2,16,25-27} A smaller proportion are at risk for dietary deficiency of protein, zinc, thiamine, pyridoxine and chromium.²⁶ Except for vitamin A and protein, women are more likely than men to have deficient diets.²⁶ According to blood levels of micronutrients, deficiencies of vitamin C, zinc, iron, protein, vitamin D and vitamin B₆ are the most frequent in the elderly.²

Two expert groups recently recommended that the Canadian diet should contain no more than 30% of energy as fat.^{30,31} Mean energy contributions from fat in the diets of two groups of Toronto seniors ranged from 33% to 40%; 22% and 32% of low income men and women, respectively, had fat intakes exceeding 40% of energy.²⁶

The major nutrition problems of elderly Canadians appear to be low energy intake and dietary deficits of calcium, zinc, iron and vitamins C, D and A, and excessive intake of dietary fat. Paradoxically, excess weight and obesity are also common. Dietary advice should emphasize nutrient-dense foods that are low in fat and cooked by nonfat methods, such as microwaving, broiling, baking and steaming. Encouragement should be given to increasing variety in the choice of foods. The inclusion of fruits, vegetables and milk products containing calcium and vitamin D in particular should be emphasized. When feasible, regular physical activity should be encouraged as a weight management strategy.

Prevention

Family physicians have a key role in preventing

nutritional deficiencies in the elderly. Almost daily they see elderly patients who may be malnourished, at risk of nutritional deficiencies or obese. Although physicians are often called upon to give nutritional advice and recommend supplementation,³² most physicians are not adequately trained to provide such advice.³³

The principles of preventive nutrition in the elderly comprise a balance between energy intake and expenditure, variety in foods and moderation in the consumption of fat, salt, caffeine and alcohol. Factors to be considered when dietary recommendations are formulated for older populations include the following.

- maintaining optimal physiologic function
- considering the possibility of existing disease
- determining optimal serum or tissue levels of nutrition
- recognizing the substantial heterogeneity of older populations
- being informed on nutrient interactions (e.g., fibre and absorption of trace elements, vitamin C and iron absorption, vitamin D and calcium absorption) and drug-nutrient interactions
- being aware of the potential toxic effects of long-term use of supplementary vitamins and minerals

If physicians are to help their elderly patients comply with dietary guidelines, they must be aware of the determinants of malnutrition. Preventive efforts can then be directed toward those at high risk. Nevertheless, it is necessary to distinguish between the ambulatory elderly in the community and those in institutions, whether acute care or long term. This last group seems to be at much greater risk for malnutrition, despite the fact that they are attended by health professionals.³⁴

Risk factors for nutrition in the elderly

The following is a list of risk factors for malnutrition in the elderly, in order of importance, based on the impact of various causal factors in different population studies.^{35,36}

- marital status, living alone and social isolation, especially after the recent loss of a spouse
- physical disability that is secondary to chronic disease
- depression and cognitive impairment
- low income
- low level of education
- the use of multiple medications
- impaired physiologic functions

Living alone, social isolation and recently bereaved

Living alone is a significant factor leading to

inadequate nutrition in the elderly, particularly in men.³⁷ Death of a spouse, life-long friend, siblings or children can produce a role change that may lead to isolation, anxiety and depression.^{35,36}

Physical disability secondary to chronic disease

In the elderly, the chief cause of disability is chronic disease, such as Parkinson's disease, severe arthritis or a cerebrovascular accident.³⁸ Dental problems and difficulty in chewing are significant factors in poor nutritional intake. In addition, disability may affect the ability to obtain and prepare food as well as to consume it.

Depression and cognitive impairment

In a study of 44 elderly Canadian women aged 75 to 94 who were receiving "Meals on Wheels", the diet of those who had been considered to be emotionally depressed contained significantly less energy, vitamins and iron (R. Owen, M. Kronl, A. Csima: unpublished data, 1991). It appears that the motivation to prepare food is diminished before the motivation to eat. If the will to eat also declines, as is seen in people more severely depressed, programs such as "Meals on Wheels" may not be sufficient for nutritional support.

Income

There is a consistent relation between poor nutritional status and low income. Effects include lack of variety, inadequate intake of selected nutrients, excess cholesterol intake and inadequate energy intake.^{29,36,39} Food is one of the flexible items for older people on low fixed incomes and limited budgets. This often creates a domino effect whereby low socioeconomic status affects self-esteem, which in turn has been shown to be associated with inadequate nutritional intake.

Imbach and colleagues²⁹ compared dietary intake in a group of elderly people in central Montreal, whose incomes were mostly below the poverty line, with 50 retired people in well-off Montreal neighbourhoods. Energy intake was deficient for all income groups but more so for the economically disadvantaged group. Calcium, vitamin D, iron, thiamine, riboflavin and niacin were deficient for the low-income group and adequate for the well-off elderly, except in the case of vitamin D and calcium for women and thiamin for men. Consumption of cheese, milk, vegetables and fruit were affected by the food budget, and nutrient-dense foods such as fish and eggs were not popular. Among the people with low income, 32% did not drink milk.

Level of education

Illiteracy has been correlated with poor health.⁴⁰ Inadequate or inappropriate nutrition education is associated with poor dietary habits and nutritional problems.

Multiple medications

The elderly are the most frequent consumers of prescription and over-the-counter medications.⁴¹ Thus, drug-nutrient interactions are most likely to occur in this group. Examples of drug-nutrient interactions are shown in Table 2. Elderly patients taking medication for arthritis had a lower quality of diet than elderly arthritics not taking medication.⁴²

Physiologic function

Loss of smell and taste by older people has been shown to significantly decrease nutritional intake. Zimmerman and Kronl⁴³ noted that vegetables of the cabbage family, such as cauliflower, turnips and brussels sprouts, are not generally well tolerated by the aged. The first taste buds lost through aging are those associated with sweetness and salt;⁴³ thus, such strongly flavoured foods are perceived as bitter. Decreased smell and taste may also result in poor appetite. The aging gastrointestinal tract may contribute to malnutrition (e.g., achlorhydria leading to decreased iron and folate absorption). Liver and kidney dysfunction may affect bioavailability and metabolism of nutrients.

Other issues of importance

Inadequate intake

Although there are a number of risk factors for malnutrition in old age, a large percentage of the elderly simply have an inadequate dietary intake. Almost one-fifth consume less than 1000 kcal/d.³⁸

Institutionalized elderly

Among elderly patients hospitalized for acute care, 17% to 65% have been shown to have PEM;⁴⁴ in long-stay institutions the prevalence of PEM is 26% to 59%.⁴⁵ Low serum albumin levels may both underestimate and overestimate the presence of PEM because mild malnutrition may exist before it is reflected in albumin levels, and liver dysfunction results in reduced albumin synthesis. Decreased immune competence, poor wound healing, increased length of hospital stay and higher morbidity and mortality rates have been found in institutionalized elderly with PEM.^{2,27,34}

Vitamin and mineral supplements

Studies among middle-class elderly have shown that 57% to 67% of healthy older men and women take vitamin supplements.³² The inappropriate use of supplements was demonstrated in a group of elderly patients at high risk of calcium deficiency who were taking supplements that contained little or no calcium.⁴⁵ Megavitamin consumption, putatively for disease prevention, can result in a number of

Table 2: Examples of drug-nutrient interactions

Drug	Result	Nutrients affected
Antipsychotic/ psychoactive	Disinterest in food, sedation	Protein-calorie intake reduced
Diuretic	Alterations in renal tubular function	Loss of sodium, potassium, zinc and magnesium
Cardiac glycoside	Anorexia, nausea, vomiting, disinterest in food	Protein-calorie intake reduced
Phenytoin, phenobarbital	Induction of hepatic enzymes	Altered vitamin D metabolism
Salicylate	Gastrointestinal blood loss	Iron deficiency
Corticosteroid	Inhibition of calcium absorption, alteration of glucose metabolism and electrolyte imbalance	Calcium imbalance (osteoporosis), hyperglycemia, sodium retention, potassium deficiency
Mineral oil laxative	Inhibition of fat- soluble vitamin absorption	Vitamin A, D, E and K malabsorption

toxic manifestations, particularly in the case of vitamins A and D. Large amounts of vitamin C can result in a rebound vitamin C deficiency when the supplements are stopped.⁴⁶ Money for supplements could be better spent on a more nutrient-dense diet. The harm is that people expect supplements to compensate for overall inadequacies in the diet.

Lipids and cholesterol

Excessive fat intake in the North American diet has been documented.⁴⁷ The evidence for the role of dietary fat in cancer, cardiovascular disease and hypertension is suggestive but not conclusive.⁴⁷ High fat intake, especially of saturated fats, contributes to elevated serum cholesterol levels and obesity. Caution is advised in interpreting these findings and making general recommendations for the elderly.

There is contradictory evidence about the clinical significance of elevated serum cholesterol levels in older people. In 30 years of follow up from the Framingham Study a positive correlation was found between high cholesterol levels and death up to the age of 50 years.⁴⁸ For those 51 to 81 years old, a similar relation was not found. The Honolulu Heart Program Study, which followed up men over the age of 65 for 12 years, showed an incidence of coronary heart disease that progressed from the lowest to the highest quartile of serum cholesterol levels.⁴⁹ In contrast, a third study of 92 elderly women, whose mean age was 82 and who were followed up for 5 years, showed that the highest mortality rate occurred in the group with the lowest average cholesterol levels;⁵⁰ the group with the highest cholesterol levels had a lower mortality rate. Differences in methods and study design may have contributed to these contradictory findings.

In light of the inconclusive evidence on optimal cholesterol levels and because many elderly have inadequate nutrient intake, it seems unwise to place dietary restrictions on the elderly.

Body mass

There is considerable evidence for a direct relation between mortality and overweight, particularly truncal obesity.⁴⁷ Insurance studies of overweight people who lost weight and became eligible for standard insurance rates showed a decline in mortality rates to levels seen in those with ideal body weight.^{51,52} Conversely, an elderly person who loses 10% of his or her body weight in 6 months or who is 20% below ideal weight should be considered at risk.

Cultural factors

People tend to behave according to their cultur-

al norms. In applying this theory to food consumption, several different behaviours can emerge that symbolize congeniality, security or reward. Some ethnic groups have food patterns that, outside their native environment, may result in inadequate intakes. Food fads, eccentricities or aversions to particular foods that supply essential nutrients have the potential to cause undernutrition.

Vegetarian diets

A study of Seventh-Day Adventists suggested that vegetarians are not necessarily at risk of nutritional deficiencies.⁵³ Although vegetarian elderly women showed nutritional intakes below current recommendations for a number of vitamins and trace elements, nonvegetarians showed a higher prevalence of deficiencies, except in vitamins B₁₂ and D. The energy intake for both groups was low.

Calcium and prevention of osteoporosis

Because of the high morbidity rate produced by osteoporosis, the role of preventive nutrition needs consideration. Type I osteoporosis seen in premenopausal women generally presents with vertebral crush fractures and fractures of the distal radius; type II osteoporosis seen in older women more commonly presents with hip and vertebral wedge fractures.⁵⁴ There is insufficient evidence for the use of calcium supplements alone to retard postmenopausal bone loss, but a high calcium intake may prove helpful if such treatment is begun years before menopause.

Vitamin D increases the absorption of calcium, and there is an age-related decline in calcium absorption. Because studies of certain elderly populations have shown low or undetectable serum levels of vitamin D, it is probably wise to recommend vitamin D supplementation, especially in elderly who are not exposed to sunlight.⁵⁵ Vitamin D probably also contributes to muscle strength.⁵⁵ The current recommendation for adults over 50 is 5 µ/d (200 IU), but the margin for safety is narrow, and hypercalcemia has been demonstrated with an intake of 50 µ/d.¹²

Fibre

The role of fibre in the diet of the elderly has been widely discussed. There is little evidence that supplementing a low-energy, high-carbohydrate diet with fibre confers any therapeutic benefit in people with type II diabetes. The benefit may be related to the amount of displacement by fibre of other dietary constituents. Fibre is important as a bowel regulator and for its contribution to preventing colon cancer.⁵⁵

In summary, for prevention and health maintenance in the elderly, the physician must be properly informed about nutrition and aware of the elderly patient's nutritional status. Enquiries should be made about the determinants of the patient's food intake. In addition, the physician must be aware of the nutritional resources available in the community and seek help from those who can offer either more time or more expertise in dealing with nutritional problems of the elderly.

Management of nutritional disorders

Nutritional problems may be a common complicating factor in many diseases that affect the elderly. Nutritional status is an important determinant of the severity of some diseases and may influence the outcome. Whenever possible, nutritional support should be instituted early in the management of geriatric patients. Physicians dealing with the elderly should suspect nutritional disorders and have the necessary skills to diagnose and manage these problems or, if necessary, to make appropriate referrals to a dietitian or nutritionist.

Oral supplements

Oral supplements are fairly inexpensive and can be used by outpatients or patients seen at home. Adequate intake of protein and energy can usually be achieved with energy-dense foods such as peanut butter, cheese and milkshakes. Complete nutritional supplements are also practical. When served chilled or warmed according to the patient's preference and in an attractive glass receptacle, most patients find such supplements acceptable. They may be added to a normal or modified consistency diet without producing satiation. When added to cream soups or given as milkshakes, they are usually well tolerated. Inadequate fluid intake should be corrected. Providing a "Meals-on-Wheels" service to home-bound elderly patients during illness can also be invaluable.

Enteral tube feeding

Enteral tube feeding is indicated when a patient is unable or refuses to eat or when dysphagia contributes to malnutrition. An institutional setting is usually required initially. Subsequent tube feeding may be performed at home if the setting is conducive and provided the caregiver feels confident and has access to home care services. Enteral hyperalimentation with a small-bore (10 French) catheter is usually provided. The tube position is confirmed radiographically before nutrient delivery. An undiluted polymeric dietary supplement is infused continuously at a rate of 25 mL/h. This is increased at

12-hour intervals so that by 48 hours, the patient is receiving 35 kcal (146 kJ) per kilogram ideal body weight, calculated from the patient's height.

Enteral hyperalimentation is continued until the patient's voluntary energy intake is considered adequate. Managed in this way, tube feeding can be conducted without limiting patient mobility or reducing voluntary ingestion of food. A uniform feature of enteral hyperalimentation via nasogastric tube is usually substantial and impressive weight gain early in the treatment. The initial weight gain may be due to fluid and fat retention. There is usually a prompt reduction in serum albumin and hemoglobin levels, which suggests early fluid retention.

Edema, electrolyte disturbances and metabolic alterations are well recognized complications of such treatment, particularly in the starved elderly. However, frequent monitoring usually prevents complications, and fluid retention is not usually severe enough to warrant therapeutic intervention. A significant rise in the serum concentrations of pre-albumin and albumin is indicative of substantial improvement in visceral protein synthesis.

Gastrotomy or jejunostomy

When tube feedings are expected to be continued for more than 3 to 4 weeks, gastrotomy or jejunostomy facilitates nursing care and alleviates the discomfort of nasogastric tubes. The newer techniques of percutaneous endoscopic placement of enteral feeding tubes causes fewer complications and is inexpensive. Pulmonary aspiration can be a complication even with gastrotomy feeding. Another significant complication of long-term gastrotomy tube feeding is stomal leakage of formula and gastric juice. This is more common with surgical gastrotomy and can usually be managed with an H₂ receptor blocker or ion-pump inhibiting drugs in recommended doses (e.g., cimetidine, ranitidine, famotidine, nizatidine and omeprazole). The development of granulation tissue at the stoma site can be decreased by anchoring the tube in such a way as to prevent rotation during feeding.

Little is known of age-related changes in tolerance, absorption or metabolic response to enteral formulas. Prescription is usually based on assessment of nutritional need, hydration of the patient and the underlying illness. Standard formulas provide 1.06 kcal/mL (4.45 kJ/mL) and are available in isotonic or hypertonic forms. Isotonicity is indicated initially with nasogastric feeding to optimize gastric emptying; it causes diarrhea less often than hypertonic preparations.⁵⁶ When used as a sole nutritional source enteral formulas are compounded to ensure adequate intake of nutrients and energy. More con-

centrated formulas are available to allow smaller volumes of fluid to be used, but dehydration may occur very rapidly in older patients if they are not carefully supervised. High-protein formulas are of value in protein-losing illnesses, and mixtures containing fibre can enhance the control of diabetes mellitus. The most common complications of enteral feeding include pulmonary aspiration, diarrhea, vomiting, constipation, continued weight loss, hyper- and hyponatremia and hyperglycemia. Most enteral formulas provide 2 g/d of sodium or less at volumes recommended by manufacturers.

The usual habit of flushing the tube after feeding and administration of medication may lead to excessive absorption of water, especially in patients with hepatic, cardiac or renal disease and particularly if diuretic therapy is being used simultaneously. In such instances, serum electrolyte levels should be monitored closely until the patient is stable.

Immobility and an inability to maintain an upright position, together with delayed gastric emptying and the presence of a tracheostomy, all predispose to aspiration. A sudden change in mental status should alert the physician to the possibility of aspiration.

Diarrhea may be associated with antibiotics, infectious agents, particularly *Clostridium difficile*, drugs, hypoalbuminemia and fecal impaction. An elemental diet or albumin infusion may alleviate diarrhea in patients with albumin levels below 25 g/L. Once all possible underlying causes of the diarrhea have been eliminated, some improvement may result from using an isotonic fibre-containing formula, slowing the rate of infusion or decreasing the volume of formula. If these measures are unsuccessful, an antidiarrheal agent should be used.

Vomiting can occur with rapid intragastric infusion and is likely with bolus feeding, hypertonic formulas or delayed gastric emptying.⁵⁷

Constipation can be a problem in those using a low-residue formula. A fibre-containing formula, prune juice and adequate fluid ingestion should be considered. Laxative preparations may cause significant electrolyte imbalance.

Continued weight loss or a failure to gain weight may be due to the underlying illness, inadequate energy intake or malabsorption. Pancreatic and biliary insufficiency have been seen in tube-fed patients.

Total parenteral nutrition

Total parenteral nutrition as a supportive treatment is less often required in the elderly than in younger patients. Whether this method of supportive nutrition is used will depend on the nature of the underlying illness and the inability of the gut to act as an absorptive route for nutrient intake. Age alone

should not be the basis for rejecting total parenteral nutrition; however, complications increase with age. Hyperglycemia and azotemia are common, and electrolyte imbalance is frequently encountered.

Nutrition and specific diseases of the elderly

Nutritional management of the elderly with specific diseases is usually no different from that of younger patients. Disorders that are commonly associated with nutritional problems in the elderly should be managed with the help of a dietitian.

Acute infection

During acute infections, the requirements for energy and protein increase by 30% to 100% depending on the type of microorganism, the site of infection, its severity and the magnitude of febrile and metabolic response.⁵⁸ Because of restricted ability to handle protein metabolites, careful monitoring of the renal threshold is indicated when protein supplements are used during infectious illnesses.⁵⁹ Almost all bacteria require iron for their growth; thus, because of potential bacterial proliferation, iron supplementation should be avoided during the first few days of acute infectious illness.⁶⁰

Cardiovascular disease

Diseases affecting the heart and blood vessels are two of the three major causes of death among the elderly in North America. Such diseases include hypertension, ischemic heart disease secondary to atherosclerosis and congestive heart failure. It is believed that diet plays a significant role in the cause and pathogenesis of these disorders and in their treatment. Extreme dietary restrictions in the elderly patient may seriously compromise energy and nutrient intakes. Nutritional advice for the elderly hypertensive patient includes weight control and, in some cases, sodium restriction. In addition, adequate intake of calcium and potassium should be ensured.

Gastrointestinal disorders

In older people, malabsorption can be caused by a number of factors such as achlorhydria, reduced enzyme and bile salt production, and bacterial overgrowth of the small intestine.⁶¹ Infections, surgery and certain drugs may also play a part. Correction of the underlying problem may not always be possible, and nutrient supplements may be needed. Hypochlorhydria reduces absorption of iron, indicating a need for supplementation.⁶² Gastric atrophy reduces intrinsic factor production, resulting in the need for parenteral B₁₂ therapy. Pancreatic insufficiency and

reduction of bile acids and salts can result in a deficiency of fat soluble vitamins and calcium.

Diabetes mellitus

Nutritional management of patients with diabetes mellitus should include weight control and adherence to the dietary guidelines. Exercise is an important adjunct. A team approach should be used.

Anemia

Specific corrective therapy should be used after identifying the deficient nutrients. Anemia caused by anti-inflammatory drug-induced gastrointestinal bleeding may require iron and vitamin C supplements. In patients receiving corticosteroids, calcium supplements are needed.⁶³

Arthritis and osteoarthritis

Pain and stiffness early in the morning and at the end of the day may decrease appetite and the ability to prepare meals. Lunch should therefore be the largest meal of the day, and mid-morning and mid-afternoon snacks to meet daily energy needs should be encouraged.

Neurodegenerative diseases

Slowness, rigidity, tremor and poor coordination can make meal times laborious and unsuccessful for many neurologically handicapped elderly patients. Dysphagia can also lead to major health hazards. Whenever possible, patients should be encouraged to remain independent in feeding. Utensils with built-up or loop handles, spouted cups, dishes with plate guards or rims, and other feeding devices should be used to maintain independence and minimize frustration. Weight loss may result from hurrying the patient rather than from the disease.

Decubitus ulcers

Obesity and cachexia may increase susceptibility to decubitus ulcers. Anemia is common, along with other nutritional abnormalities. Serum levels of zinc, iron, protein, folate, vitamin B₁₂, vitamin C and riboflavin may be decreased, and dehydration is a common complication. If adequate nutrition is maintained with a high-protein diet supplemented with other appropriate nutrients, wound healing may actually be promoted. Local applications of zinc cream is helpful.

Kidney disease

Kidney disease is common in the elderly. Its

nutritional management is the same as that in younger age groups.

Osteoporosis

Osteoporosis is the most common bone disorder and the most disabling of diseases in the elderly, particularly women. Nutritional factors that increase the risk of this condition include low calcium intake for many years, low body weight, excessive protein intake, and excessive consumption of coffee or alcohol. Lactose intolerance has also been implicated.⁶⁴

Therapeutic intervention studies have revealed reductions in cortical but not in trabecular bone in postmenopausal women given calcium supplements.⁶⁵ Such therapy has not been demonstrated convincingly to result in a decreased frequency of fractures. Although no therapeutic treatment has been proved effective, limited success has been achieved with calcium, vitamin D, fluoride and estrogen therapy. The best management is prevention.

Osteomalacia

Osteomalacia is a metabolic bone disease characterized by a mineralization defect in the bone matrix, leading to bone deformity, fracture and pain. Primary or secondary vitamin D deficiency can lead to osteomalacia. Management includes vitamin D therapy with supplemental calcium (1 to 2 g/d).⁶⁶

Conclusion

Much background work has pointed to the important role of diet and nutrition in the health status of the elderly. Patients who have obvious nutritional problems, both undernutrition and overnutrition, are likely to suffer more disability and are at greater risk of premature death than elderly patients without nutritional problems.

Physicians must suspect nutritional disorders in the elderly. A detailed clinical history, which may be preceded by a self-administered questionnaire (Appendix 1), will indicate whether the person is at moderate or high risk of nutritional deficiencies. A thorough physical examination including measurement of weight and height will confirm the presence of clinically significant protein-calorie malnutrition. For common nutrient deficiencies a few screening tests may be required, such as measurements of serum albumin and hemoglobin levels. In selected instances, it may be necessary to order additional laboratory tests and to refer the patient to a nutritionist for more detailed assessment.

The important role of nutrition in regulation of

physiologic functions justifies attention to the role of dietary factors in both prevention and management of common geriatric problems. In many illnesses, the risk of occurrence and severity of complications can be minimized by attempting to correct associated nutritional disorders. It is preferable to use a team approach whereby the physician, nutritionist and nurse each have a defined interactive role. In addition, home care providers and other support services (e.g., "Meals on Wheels") are an important adjunct in continuing care.

Physicians and other health professionals generally receive very little training in recognizing and managing nutritional disorders. It is essential, therefore, for them to take part in continuing education programs to update their knowledge and equip them to manage nutrition-associated problems in their patients.

Finally, there are many gaps in our knowledge of the role of nutrition in maintaining optimum health and function in old age, nutrient requirements, reference standards for anthropometry and laboratory tests and so forth. Additional research efforts are therefore needed in this important area of preventive and therapeutic medicine.

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Appendix 1: Questionnaire to identify elderly people at high risk of nutritional deficiencies

Variable	Answer	Score*
Age?	> 75	1
Do you live alone?	Yes	2
Do you have a disability or illness that makes it difficult to obtain groceries or prepare food?	Yes	2
Have you lost a close relative or friend in the last year?	Yes	2
Have you lost weight in the past year?	Yes	2
Are you eating foods from each of the following food groups every week?	No	1
Bread and cereals		
Milk and other dairy products		
Fruits and vegetables		
Meat, fish and poultry, including eggs		
Do you suffer from lack of appetite?	Yes	1
Do you suffer from diarrhea?	Yes	1
Do you suffer from lack of smell or taste?	Yes	1
Do you find that food prices stress your budget?	Yes	2
Do you take more than two medications daily?	Yes	1
Do you drink more than four cups of tea or coffee daily?	Yes	1
How many alcoholic beverages do you drink daily?		
3-5	-	1
> 5	-	2
Do you take any vitamin or mineral supplements?	Yes	-2

*Score of 10 or greater = high risk of nutritional problems

Action: Detailed physical examination, anthropometry, blood tests, nutrition advice, consultation with dietitian, regular follow up.

Score of 5-10 = moderate risk

Action: Physical examination, anthropometry, selected blood tests, nutrition advice, follow up in 3 to 4 months.

Score of less than 5 = low risk

Action: General advice about nutrition.